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SIGNIFICANCE OF INTERREGIONAL FEEDBACKS FOR CANADIAN AND REGIONAL ENERGY POLICY DECISIONS

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PREFACE

The work for this paper was carried out in the period October 1981 to February 1982. The detailed expenditure data required to perform the analysis were provided by Alsands Energy Ltd. Between March and August 1981, CERI evaluated the economic impact of the construction and operation of the Alsands project under a research contract with Alsands. The data were provided in order to conduct this evaluation.

SIGNIFICANCE OF INTERREGIONAL FEEDBACKS FOR CANADIAN AND REGIONAL ENERGY POLICY DECISIONS

1. INTRODUCTION

Discussions of interregional feedback effects (see, for example Miller [4,5], Greytak [2,3], and Gillen and Guccione [1]) have emphasized technical and theoretical characteristics of regional models. The purpose of this paper is to illustrate the significance and variability of feedback effects in analyzing the regional impacts of a major Canadian energy investment.

Alsands Energy Ltd. which is a consortium of nine oil companies is proposing to spend 13.1 billion dollars (7.9 billion 1980 dollars) in constructing a tar sands plant in northeastern Alberta. The construction phase will require 53,000 man years of employment. Information on the regional distribution of the impacts generated by the large project is essential for manpower, industrial and government planning. Sensitivity analysis can provide bounds on errors associated with critical data assumptions with respect to availability of local workers and capacity of the local material and equipment supply industries. Explicit analysis of the variability due to inaccurate data is required because impact analyses are always carried out with models based on data which is several years out of date. Furthermore, in ex ante analyses the actual data distributions are not known.

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The first section of the paper briefly describes the Canadian regional model. Second, feedback effects are estimated and their significance discussed. Third, the sensitivity of feedback effects to alternative data assumptions is examined.

2. DESCRIPTION OF THE CANADIAN REGIONAL MODEL AND IMPACTS

The accounting framework used in the Canadian interprovincial model [6] is an extension of the national input-output accounting framework with detail on 191 industries and 602 commodities for 11 regions:

$$(1)\quad g = (I - DRB)^{-1} DRe$$
$$(2)\quad q = r(I - BDR)^{-1} e$$
$$(3)\quad m = M(I - BDR)^{-1} e$$

where g, q, m and e are regional vectors of industry output, commodity output, commodity imports, and exogenous demand, respectively. D, B, R and M are regional matrices giving the industry share of commodity production, commodity share of industry production, share of the total supply of commodities consumed in a region which were produced in the region, and import shares, respectively. The distinguishing feature of the Canadian input-output accounting framework is its rectangular shape. There is an inequality between commodities in the transaction dimension and industries in the institutional dimension. The version of the regional model used is closed with respect to household income and calculates employment from employment to output ratios. Estimates of final demand and import purchases for construction of the tar sands plant were obtained from unpublished Alsands engineering studies. The results for plant construction are summarized in Table 1.

The plant construction expenditure of $7,910 (millions of 1980 dollars) is separated into Canadian purchases and imports. Canadian purchases ($6,458) are deflated to $3,671 in 1974 dollars using commodity deflators. Individual commodity deflators are used rather than an aggregate price measure to ensure that the relative volumes of materials, services and factor services implicit in the 1980 data flow through the 1974 based model. The direct income component associated with the construction is made up of factor incomes of $1,900 and gross domestic product at market prices associated with materials purchases of $883. Direct gross domestic product at market prices is $2,783. The version of the model is closed with respect to household income and estimates a direct, indirect and induced income effect of $5,771. The resulting multiplier for Canada is 2.07.

TABLE 1

Expenditures of Alsands Energy Ltd. Plant Construction Expenditure Economic Impact*

	Expenditures (millions of 1974 dollars)	Income Impact** (millions of 1974 dollars)	Employment Impact (thousands of man years)
Quebec	302	672	25.2
Ontario	941	1622	56.7
Alberta	2198	2882	82.4
Canada	3671	5771	184.5

* 1980 expenditures estimates obtained from Alsands engineering studies were deflated to a 1974 base and impacts were calculated using the Statistics Canada Interprovincial Input-Output Model.

** The income measure used is Gross Domestic Product at Market Prices.

3. SIGNIFICANCE OF FEEDBACK EFFECTS

Gillen and Guccione observe that feedback effects depend only on the interregional interindustry coefficients which are independent of final demand and that errors resulting from neglecting feedback effects increase with a fall in the degree of self-sufficiency of either region. With respect to the Canadian interregional structure Alberta has a self-sufficiency ratio of (.47) compared to a ratio of (.54) for Ontario (Table 2).

TABLE 2

Self-Supply Ratios*, 1974

Newfoundland	.18
Prince Edward Island	.27
Nova Scotia	.28
New Brunswick	.29
Quebec	.47
Ontario	.54
Manitoba	.40
Saskatchewan	.31
Alberta	.47
British Columbia	.45
Yukon and Northwest Territories	.09

* Self-supply ratios are calculated as the ratio of province's production staying in province to total supply from the Statistics Canada regional model.

From the perspective of national regional policy, the isolation of impacts on Alberta, Ontario and Quebec are important because significant benefits occur for these regions. Ex ante, from Alberta's perspective, the feedback due to purchases from other provinces may or may not be significant relative to Alberta multiplier effects calculated

using only the first round energy final demand purchases. From the point of view of Ontario and other provinces, the impact of final purchases associated with the energy project are important but again the magnitude of the feedback effects from other provinces are not known. Results (Table 3) indicate the income and employment impact of the energy final demand expenditures on Alberta, Ontario and Quebec with and without feedback effects. As can be seen, the interregional feedback effects of constructing the Alsands tar sands plant are very significant in Ontario and Quebec and of minor importance in Alberta. Total income is higher by 88 percent, 49 percent and 2 percent for Quebec, Ontario and Alberta respectively by including interprovincial feedback. Similar effects occur on employment.

4. SENSITIVITY OF ECONOMIC IMPACT DUE TO ALTERNATIVE DATA ASSUMPTIONS

The most important data assumptions refer to the location of production and migration. We have produced four alternative scenarios to examine the effect of changed assumptions:

1) more production in Alberta
2) fewer imports
3) more employment in Alberta
4) less employment in Alberta

In the first scenario, the production of goods and services for the tar sands plant by Alberta firms is augmented by 20 percent. Production in other provinces is decreased proportionately. In the second, the import bill for goods and services is decreased by 20 percent and allocated proportionately to all other provinces. It is assumed that factor payments associated with plant construction remain

TABLE 3

INTERREGIONAL FEEDBACK EFFECTS*
(millions of 1974 dollars or thousands of man-years)

	Without Feedback		With Feedback	
	Income	Employment	Income	Employment
Quebec				
Direct	211	7.1	211	7.1
Indirect	35	1.4	97	4.0
Induced	111	3.9	364	14.1
TOTAL	357	12.4	672	25.2
Ontario				
Direct	526	18.2	526	18.2
Indirect	216	8.1	308	11.6
Induced	347	11.1	788	26.9
TOTAL	1,089	37.4	1,622	56.7
Alberta				
Direct	1821	53.2	1821	53.2
Indirect	157	4.6	169	4.7
Induced	845	23.5	892	24.5
TOTAL	2,823	81.2	2,882	82.4

*The Statistics Canada regional model contains a set of provincial input-output coefficients. The provincial model coefficients were used to calculate effects without feedbacks.

unchanged in these two scenarios. The third scenario reduces Alberta employment by 20 percent with employment in other provinces increased proportionately. In the fourth scenario, employment outside Alberta is reduced by 20 percent and Alberta employment increased by an equal amount. In the third and fourth scenarios, we assume that the wage bill is proportional to employment and the average productivity of workers is the same irrespective of the province of origin. Because the Alberta economy is currently enjoying low unemployment rates (the 1981 average was 3.8 percent with a monthly low of 2.9 percent recorded in June) and because these low rates are expected to persist throughout the 1980's, additional local employment must come about through net migration from other provinces.[1]

Table 4 compares the economic impact of these four scenarios to the base case. In the case where production in Alberta is augmented by 20 percent, the impact on Alberta income increases by 5 percent while Ontario and Quebec lose 8 percent and 5 percent respectively of their income impact. If the tar sands plant construction required a 20 percent lower import bill the income impact in Ontario, Quebec and Alberta would be amplified by 7 percent, 5 percent and 1 percent respectively. If there were more employment in Alberta and hence migration to that province, its income impact would rise by 5.5 percent. Ontario and Quebec income impacts would decline by 3 percent and 5 percent respectively. In the last case where there is less employment in Alberta,

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[1]The Canadian Labour force in 1981 was 11.8 million persons. Of these, 4.5, 3.0 and 1.1 million were residents of Ontario, Quebec and Alberta respectively.

TABLE 4

ECONOMIC IMPACT UNDER DIFFERENT DATA ASSUMPTIONS
(millions of 1974 dollars or thousands of man years)

	Quebec		Ontario		Alberta	
	Income	Employment	Income	Employment	Income	Employment
Base Case						
Direct	211	7.1	526	18.2	1,821	53.2
Indirect	97	4.0	308	11.6	169	4.7
Induced	364	14.1	788	26.9	892	24.5
TOTAL	672	25.2	1,622	56.7	2,882	82.4
More Production in Alberta						
Direct	195	6.3	458	15.4	1,906	56.6
Indirect	88	3.7	278	10.5	198	5.8
Induced	353	13.8	754	25.9	935	25.7
TOTAL	636	23.8	1,490	51.8	3,039	88.1
Fewer Imports						
Direct	219	7.4	563	19.5	1,837	53.8
Indirect	107	4.4	339	12.8	177	5.0
Induced	377	14.7	826	28.2	904	24.7
TOTAL	703	26.5	1,728	60.5	2,918	83.5
More Employment In Alberta						
Direct	188	6.4	497	17.3	1,926	56.5
Indirect	97	4.0	308	11.6	169	4.7
Induced	353	13.8	776	26.6	946	26.0
TOTAL	638	24.2	1,581	55.5	3,041	87.2
Less Employment in Alberta						
Direct	263	8.7	591	20.3	1,581	45.7
Indirect	97	4.0	308	11.6	169	4.7
Induced	388	14.9	815	27.7	769	21.0
TOTAL	748	27.6	1,714	59.6	2,519	71.4

the impact on income in Ontario and Quebec is enhanced by 6 percent and 11 percent respectively. Alberta's income impact is mitigated by 13 percent.

5. CONCLUSIONS

The results indicate the important information which can be provided with respect to the regional distribution of benefits of large energy projects throughout a national economy. Regional input-output impact analysis is a useful method of documenting the benefits of energy development in Western Canada for Ontario and Quebec. It is also of interest to note that benefits to other Canadian provinces are not large. In the Canadian energy impact case the size and structure of the respective regional economies are the critical indicators of the importance of interregional feedback effects. Spending by Alberta workers and material purchases in Alberta create large interregional feedback effects in Ontario and Quebec. Interregional feedback effects are therefore more critical for economic planning in Ontario and Quebec relative to other provinces. The regional distribution of impacts within a national economy stemming from large development projects and sensitivity analyses do not appear to have been emphasized as important uses of regional input-output models.

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